34
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up-to-date electronics for lab and leisure

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throwing some light on LEDs

CMOS function generator

development timer

infra-red light gate

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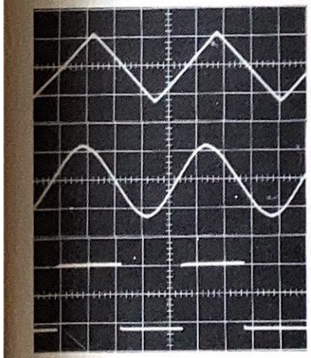
The **infra-red light gate** can be used in a wide variety of applications ranging from intruder alarms to automatic garage door openers. When the light beam from the infra-red source is interrupted, the receiver circuit detects this and energises a relay.

'Throwing some light on LEDs' aims to dispel some of the mystery surrounding LEDs, so that the constructor can choose the most suitable type for his requirements, and calculate the operating conditions.



Using only one inexpensive CMOS IC and a handful of discrete components, it is possible to build a versatile **CMOS function generator** that will provide a choice of three waveforms over the entire audio spectrum and beyond.

The reason why LED displays are becoming ever more popular is obvious: they look so neat! Quite apart from being reliable and requiring relatively little power.

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formant — the elektor music synthesiser (8) . . 2-10
C. Chapman
This article continues the discussion of the tone-forming circuits with a description of the Dual VCA module, which can be used in conjunction with the envelope shaper for dynamic control of signal amplitude, and also for periodic amplitude modulation of the signal waveform (tremolo).

slow on/off 2-17
The slow on/off fader circuit will fade the lighting up and down slowly, rather than switching it on and off abruptly.

CMOS function generator 2-20

zener tester 2-22
This simple tester provides a reliable means of measuring zener voltages and of plotting the variation of zener voltage with zener current.

development timer 2-24
Developing photographic films can be something of a chore. Not only is it necessary to measure the total development time, but it is also necessary to agitate the development tank at frequent intervals to ensure even development of the film. This means that the clock must be watched continuously. The development timer described in this article overcomes these problems by measuring the intervals at which and the length of time for which the tank must be agitated, as well as the total development time.

experimenting with the SC/MP (4) 2-28
H. Kampschulte, H. Huschitt
By abolishing the restriction of having to work exclusively in binary code, the hexadecimal input/output unit described in this article considerably increases the ease and speed with which the user can communicate with the SC/MP — providing, of course, that he has a thorough grasp of the relevant software.

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elektor 34

Volume 4 Number 2

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decoder

What is a TUN?
What is 10 n?
What is the EPS service?
What is the TQ service?
What is a missing link?

Semiconductor types
Very often, a large number of equivalent semiconductors exist with different type numbers. For this reason, 'abbreviated' type numbers are used in Elektor wherever possible:

- '741' stand for µA741, LM741, MC641, MIC741, RM741, SN72741, etc.
- 'TUP' or 'TUN' (Transistor, Universal, PNP or NPN respectively) stand for any low frequency silicon transistor that meets the following specifications:

UCEO, max	20V
IC, max	100 mA
hfe, min	100
Ptot, max	100 mW
fT, min	100 MHz

Some **'TUN'**s are: BC107, BC108 and BC109 families; 2N3856A, 2N3859, 2N3860, 2N3904, 2N3947, 2N4124. Some **'TUP'**s are: BC177 and BC178 families; BC179 family with the possible exeption of BC159 and BC179; 2N2412, 2N3251, 2N3906, 2N4126, 2N4291.

- 'DUS' or 'DUG' (Diode Universal, Silicon or Germanium respectively) stands for any diode that meets the following specifications:

	DUS	DUG
UR, max	25V	20V
IF, max	100mA	35mA
IR, max	1µA	100 µA
Ptot, max	250mW	250mW
CD, max	5pF	10pF

Some **'DUS'**s are: BA127, BA217, BA218, BA221, BA222, BA317, BA318, BAX13 BAY61, 1N914, 1N4148.
Some **'DUG'**s are: OA85, OA91, OA95, AA116.

- 'BC107B', 'BC237B', 'BC547B' all refer to the same 'family' of almost identical better-quality silicon transistors. In general, any other member of the same family can be used instead.

BC107 (-8, -9) families:
BC107 (-8, -9), BC147 (-8, -9), BC207 (-8, -9), BC237 (-8, -9), BC317 (-8, -9), BC347 (-8, -9), BC547 (-8, -9), BC171 (-2, -3), BC182 (-3, -4), BC382 (-3, -4), BC437 (-8, -9), BC414

BC177 (-8, -9) families:
BC177 (-8, -9), BC157 (-8, -9), BC204 (-5, -6), BC307 (-8, -9), BC320 (-1, -2), BC350 (-1, -2), BC557 (-8, -9), BC251 (-2, -3), BC212 (-3, -4), BC512 (-3, -4), BC261 (-2, -3), BC416.

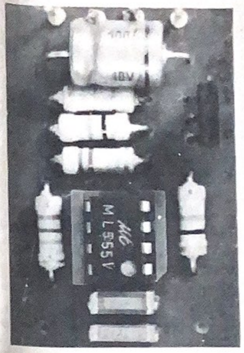
Resistor and capacitor values
When giving component values, decimal points and large numbers of zeros are avoided wherever possible. The decimal point is usually replaced by one of the following abbreviations:
p (pico-) = 10^{-12}
n (nano-) = 10^{-9}
µ (micro-) = 10^{-6}
m (milli-) = 10^{-3}
k (kilo-) = 10^{3}
M (mega-) = 10^{6}
G (giga-) = 10^{9}
A few examples:
Resistance value 2k7: 2700 Ω.
Resistance value 470: 470 Ω.
Capacitance value 4p7: 4.7 pF, or 0.000 000 000 004 7 F . . .
Capacitance value 10n: this is the international way of writing 10,000 pF or .01 µF, since 1 n is 10^{-9} farads or 1000 pF.
Resistors are ¼ Watt 5% carbon types, unless otherwise specified.
The DC working voltage of capacitors (other than electrolytics) is normally assumed to be at least 60 V. As a rule of thumb, a safe value is usually approximately twice the DC supply voltage.

Test voltages
The DC test voltages shown are measured with a 20 kΩ/V instrument, unless otherwise specified.

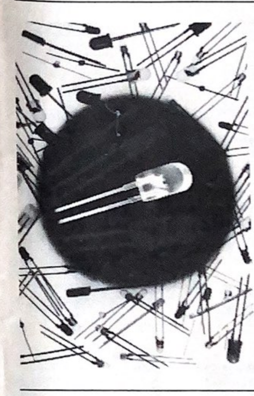
U, not V
The international letter symbol 'U' for voltage is often used instead of the ambiguous 'V'. 'V' is normally reserved for 'volts'. For instance: $U_b = 10$ V, not $V_b = 10$ V.

Mains voltages
No mains (power line) voltages are listed in Elektor circuits. It is assumed that our readers know what voltage is standard in their part of the world!
Readers in countries that use 60 Hz should note that Elektor circuits are designed for 50 Hz operation. This will not normally be a problem; however, in cases where the mains frequency is used for synchronisation some modification may be required.

Technical services to readers
- **EPS service.** Many Elektor articles include a lay-out for a printed circuit board. Some — but not all — of these boards are available ready-etched and predrilled. The 'EPS print service list' in the current issue always gives a complete list of available boards.
- **Technical queries.** Members of the technical staff are available to answer technical queries (relating to articles published in Elektor) by telephone on Mondays from 14.00 to 16.30. Letters with technical queries should be addressed to: Dept. TQ. Please enclose a stamped, self addressed envelope; readers outside U.K. please enclose an IRC instead of stamps.
- **Missing link.** Any important modifications to, additions to, improvements on or corrections in Elektor circuits are generally listed under the heading 'Missing Link' at the earliest opportunity.



The **infra-red l**
can be used in
variety of appl
ranging from i
alarms to auto
garage door op
When the light
the infra-red s
interrupted, th
circuit detects
energises a rela



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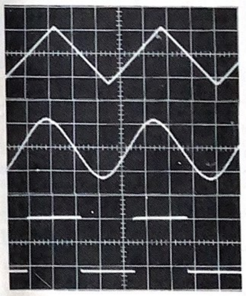

Using only c
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TTLs by TEXAS

7400	16p
7401	18p
7402	18p
7403	18p
7404	24p
7405	25p
7406	43p
7407	43p
7408	22p
7409	22p
7410	18p
7411	26p
7412	25p
7413	40p
7414	85p
7416	40p
7417	40p
7420	18p
7421	43p
7422	28p
7423	36p
7425	33p
7426	43p
7427	40p
7428	4op
7430	18p
7432	37p
7433	43p
7437	37p
7438	37p
7440	18p
7441	85p
7442	75p
7443	120p
7444	120p
7445	108p
7446	108p
7447	90p
7448	85p
7450	18p
7451	18p
7453	18p
7454	18p
7460	18p
7470	38p
7472	32p
7473	36p
7474	37p
7475	48p
7476	37p
7480	54p
7481	108p
7482	90p
7483	99p
7484	108p
7485	120p
7486	36p
7489	340p
7490	36p
7491	90p
7492	58p
7493	36p
7494	90p
7495	75p
7496	90p
7497	290p
74100	140p
74104	75p
74105	75p
74107	36p
74109	60p
74110	60p
74111	75p
74112	96p
74116	216p
74118	160p
74119	225p
74120	130p
74121	32p
74122	52p
74123	75p
74125	70p
74126	65p
74128	82p
74132	81p
74136	81p
74141	85p
74142	300p
74145	95p
74147	205p
74148	160p
74150	130p
74151	81p
74153	81p
74154	160p
74155	97p
74156	97p
74157	97p
74159	250p
74160	130p
74161	130p
74162	130p
74163	130p
74164	140p
74165	150p
74166	160p
74167	320p
74170	260p
74172	750p
74173	190p
74174	130p
74175	97p
74176	130p
74177	120p
74180	120p
74181	324p
74182	150p
74184	346p
74185	190p
74186	990p
74190	160p
74191	160p
74192	130p
74193	130p
74194	160p
74195	110p
74196	130p
74197	130p
74198	250p
74199	250p
74221	175p
74251	150p
74265	97p
74278	320p
74279	150p
74283	220p
74284	475p
74285	475p
74290	160p
74294	160p
74298	220p
74365	160p
74366	160p
74367	160p
74390	220p
74393	245p
74490	250p

100+ less 10%
300+ less 15%
500+ less 20%

CMOS I.C.s

4000	21p
4001	21p
4002	21p
4006	127p
4007	21p
4008	180p
4009	67p
4010	67p
4011	21p
4012	23p
4013	55p
4014	90p
4015	90p
4016	54p
4017	120p
4018	110p
4019	57p
4020	140p
4021	120p
4022	140p
4023	23p
4024	90p
4025	23p
4026	200p
4027	64p
4028	110p
4029	120p
4030	67p
4040	150p
4042	97p
4043	100p
4044	110p
4046	150p
4047	120p
4049	64p
4050	58p
4054	120p
4055	140p
4056	145p
4060	130p
4068	30p
4069	30p
4071	30p
4072	45p
4073	30p
4078	30p
4081	30p
4082	104p
4093	97p
4510	140p
4511	130p
4516	130p
4518	140p
4528	140p
14433	£1400
14533	540p
14583	150p

Other

75107	175p
75182	250p
75451	84p
9301	175p
9302	190p
9308	340p
9310	305p
9311	305p
9312	175p
9314	185p
9316	250p
9318	300p
9321	175p
9322	165p
9324	270p
9601	190p
9602	190p

OP. AMPS.

CA3130	108p	709	40p
CA3140	108p	733	150p
CA3160	120p	741	25p
LM301A	40p	747	75p
LM318N	175p	748	40p
LM324N	130p	776	216p
MC1458P	75p	3900	70p
NE531V	140p		

LINEAR I.Cs.

		NE555	40p
		NE556	97p
AY-1-0212	650p	NE561B	450p
AY-3-8500	775p	NE562B	450p
CA3028A	112p	NE565	200p
CA3046	85p	NE566	200p
CA3048	250p	NE567	200p
CA3053	75p	RC4151N	432p
CA3065	200p	SN72710N	54p
CA3080E	97p	SN76003N	275p
CA3089E	250p	SN26008	280p
CA3090AQ	425p	SN76013N	175p
ICL8038CC	400p	SN76013ND	160p
LM339N	175p	SN76018	280p
LM377N	200p	SN76023N	175p
LM380N	112p	SN76023ND	160p
LM381N	190p	SP8515	710p
LM389N	160p	TAA621A	310p
M252AA	850p	TAA661A	150p
MC1310P	190p	TBA120	97p
MC1351P	110p	TBA641B	300p
MC1495L	490p	TBA651	225p
MC1496L	112p	TBA800	112p
MC3340P	180p	TBA810	125p
MC3360P	160p	TBA820	100p
MFC4000B	120p	TDA2020	405p
NE540L	216p	ZN414	140p

VOLTAGE REGULATORS — Fixed

Plastic — TO220 — 3 Terminals

1 Amp +ve			1 Amp −ve		
5V	7805	115p	5V	7905	160p
6V	7806	115p	12V	7912	160p
8V	7808	115p	15V	7915	160p
12V	7812	115p	24V	7924	160p
15V	7815	115p			
18V	7818	115p			
24V	7824	115p			

Heat Sink 17°/W 25p suitable for T0220

100mA +ve T092			100mA −ve TO92		
5V	78L05	70p	5V	79LO5	80p
6.2V	78L62	70p			
12V	78L12	70p	12V	79L12	80p
15V	78L15	70p	15V	79L15	80p

LM309K	T03	150p	MC1468	DIL	300p
LM323K	T03	700p	TBA625B	T05	120p
LM327N	DIL	275p	7805K	T03	150p

VARIABLE:

723	D'L	45p	LM317	T0220	325p
78MGT2C		145p	TL430	T092	70p

OPTO-ELECTRONICS

OCP 71	130p
ORP 12	100p
ORP 60	90p
ORP 61	90p
2N5777	48p

LEDs

TIL209	Red	14p
TIL211	Green	25p
TIL32	Infrared	81p
0.2"	Red	16p
0.2"	Green	20p
0.2"	Amber	36p

DISPLAYS

3015F	Minitron	200p
FND 500/507	Red	130p
DL704	Red/Green	160p
DL707	Red/Green	160p
DL747	Red/Green	250p
TIL 321/322	Red	130p

Drivers

75492	84p
75492	96p
9368	200p
9374	200p

MEMORY I.Cs.

1702A	EPROM	875p
2102-2	RAM	216p
2107	RAM	864p
2112-2	RAM	470p
8080A	C.P.U.	£14
AY5-1013	UART	725p
RO3-2513	ROM	850p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	12p	22 pin	36p
14 pin	13p	24 pin	40p
16 pin	14p	28 pin	48p
18 pin	30p	40 pin	60p

TRANSISTORS

AC125/6	20p	BD139	56p
AC127/8	20p	BD140	60p
AC176	20p	BDY56	225p
AC187/8	20p	BF115	24p
AD149	60p	BF167	25p
AD161	45p	BF170	25p
AD162	48p	BF173	27p
AF114/5	30p	BF178	30p
AF116/7	30p	BF179	35p
AF127	40p	BF180/1	35p
AF139	40p	BF184/5	24p
AF239	48p	BF194	13p
BC107/B	10p	BF195	11p
BC108/B	10p	BF196	17p
BC109	10p	BF197	19p
BC109C	11p	BF200	40p
BC147	9p	BF244B	34p
BC148	8p	BF256B	60p
BC157	11p	BF257	34p
BC158/9	13p	BF258	39p
BC169C	15p	BF259	48p
BC172	11p	BF337	32p
BC177	20p	BFR39	34p
BC178	17p	PFR40/1	34p
BC179	20p	BFR79	34p
BC182/3	12p	BFR80/1	34p
BC184	14p	BFR88	37p
BC187	32p	BFW10	90p
BC212	14p	BFX30	34p
BC213	12p	BFX84/5	30p
BC214	16p	BFX86/7	30p
BC461	40p	BFX28	30p
BC478	32p	BFY50	22p
BC516	65p	BFY51	22p
BC517	70p	BFY52	22p
BC547B	14p	BFY90	90p
BC549C	20p	BRY39	48p
BC557B	20p	BSX19/20	20p
BC559C	22p	MJE340	70p
BCY70	20p	MJ481	175p
BCY71	24p	MJ491	216p
BD124	140p	MJ2501	250p
BD131/2	65p	MJ2955	130p
BD135/6	54p	MJE2955	130p

MJ3001	250p
MJE3055	90p
MPF102/3	45p
MPF104/5	40p
MPSA06	37p
MPSA12	62p
MPSA56	40p
MPSU05	72p
MPSU06	78p
MPSU55	90p
MPSU56	98p
OC28	90p
OC35	90p
OC71	32p
R2008B	225p
R2010B	225p
TIP29A	50p
TIP29C	62p
TIP30A	60p
TIP30C	72p
TIP31A	56p
TIP31C	68p
TIP32A	63p
TIP32C	85p
TIP33A	97p
TIP33C	120p
TIP34A	124p
TIP34C	160p
TIP35A	243p
TIP35C	290p
TIP36A	297p
TIP36C	360p
TIP41A	70p
TIP41C	84p
TIP42A	76p
TIP42C	96p
TIP2955	76p
TIP3055	60p
TIS43	40p
2N697	25p
2N698	43p
2N706/8	22p
2N918	43p
2N930	22p
2N1131/2	25p
2N1304/5	75p
2N1306/7	75p
2N1613	22p
2N1711	22p
2N1893	32p
2N2102	60p
2N2160	120p
2N2219/A	22p
2N2222/A	22p
2N2369	15p
2N2484	32p
2N2646	52p
2N2904/A	22p
2N2905/A	22p
2N2906/A	22p
2N2907/A	25p

		2N5179	75p
2N2926RB	9p	2N5245	40p
2N2926OG	11p	2N5296	56p
2N3053	22p	2N54C1	62p
2N3054	65p	2N5457/8	40p
2N3055	65p	2N5459	40p
2N3442	151p	2N5485	45p
2N3643	54p	2N6107	70p
2N3644	54p	2N6027	60p
2N3702/3	14p	2N6247	200p
2N3704/5	14p	2N6254	140p
2N3706/7	14p	2N6292	70p
2N3708/9	14p	3N128	90p
2N3773	320p	3N140	97p
2N3819	27p	3N141	90p
2N3820	50p	3N187	200p
2N3823	70p	40360	43p
2N3866	97p	40361/2	43p
2N3903/4	22p	40409/10	75p
2N3905/6	22p	40411	325p
2N4058	19p	40594	90p
2N4060	19p	40595	97p
2N4123/4	22p	40635	60p
2N4125/6	22p	40636	140p
2N4401/3	34p	40673	58p
2N4427	97p	40871	85p
2N4871	60p	40872	90p

DIODES

BY127	12p
OA47	9p
OA81	15p
OA85	15p
OA90	9p
OA91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4001/2	6p
1N4003/4	7p
1N4005/7	8p
1N4148	4p
1N5401/3	15p
1N5404/7	20p

BRIDGE RECTIFIERS

1A	50V	25p
1A	100V	27p
1A	400V	31p
2A	50V	40p
2A	100V	45p
2A	200V	55p
3A	200V	70p
3A	600V	80p
4A	100V	90p
4A	400V	96p
6A	50V	96p
6A	100V	108p
6A	400V	120p
10A	400V	270p
25A	400V	432p

ZENERS

2.7V −33V

400mW	11p
1 W	22p

TRIACS Plastic

3A	400V	85p
6A	400V	107p
6A	500V	120p
10A	400V	140p
10A	500V	160p
15A	400V	200p
15A	500V	225p
40430	T066	130p
40669	T0220	130p

SCR-THYRISTORS

1A	50V	T05	65p	BT106	Stud	150p
1A	400V	T05	95p	C106D	Plastic	70p
3A	400V	Stud	120p	MCR101	T092	30p
7A	400V	T05	130p	2N4444	Plastic	?00p
12A	400V	T0220	180p	2N5060/2/4	T092	40p
16A	400V	T0220	220p			

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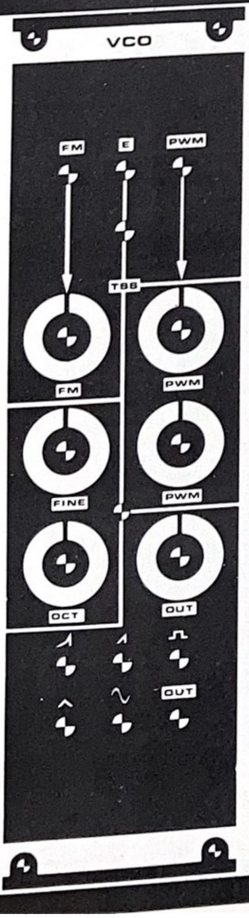

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Example:

$\underset{1}{\text{digisplay}}\quad \underbrace{\text{(E13)}}_{2}\quad \underbrace{9376}_{3}\downarrow_{4}\quad \underbrace{3.10}_{5}\downarrow_{6}\quad \underbrace{6.90}_{7}$

1. Circuit title
2. reference to associated article(s)
3. board number
4. * = p.c.b.'s without solder mask

U.K.:

5. price (in £) inclusive of VAT
6. + = 12.5% VAT; otherwise 8% VAT

U.S.A. and Canada:

7. price in $, not including tax (if any)

		£	$
E1: DECEMBER 1974			
equa amplifier	1499*	1.80+	3.95
mos clock 5314 clock circuit (E4)	1607A*	1.80	3.95
mos clock 5314 display board	1607B*	1.35	2.95
E3: APRIL 1975			
disc preamp 76131	4040A*	1.25	2.80
E4: JUNE 1975			
mos clock timebase (E1)	1620*	0.95	2.10
E7: NOVEMBER 1975			
ota pll	6029*	1.40+	3.10
tv tennis, main pcb (E13)	9029-1 A	4.80	10.55
tv tennis, modulator/ oscillator	9029-2	1.15	2.50
tv tennis, 5-volt supply	9218A	1.00	2.20
frequency counter, minitron display board	9312	1.45	3.20
frequency counter, led display board	9313	1.45	3.20
frequency counter, counter/latch/display driver	9314	1.20	2.60
E8: DECEMBER 1975			
die	9169	0.85	1.90
730/740 (IC control amplifier)	9191	1.40+	3.10
E9: JANUARY 1976			
feedback pll fm receiver (3 boards)	9356	5.30+	11.70
E11: MARCH 1976			
integrated voltage regulator	7043b	0.95+	2.10
E12: APRIL 1976			
stylus balance	9343	0.45+	1.05
rhythm generator (M253AA)	9344-3	1.45+	3.20
ic drummer, instruments mother board	9344-2	2.00+	4.40
ic drummer, instruments daughter board	9344-1	0.35+	0.80
polaroid timer	9379	1.45+	3.20
UAA170, 270° meter, basic board (E17)	9392-1	1.50	3.30
UAA170, 270° meter front panel (E17)	9392-2	2.00	4.40
UAA170, LED voltmeter, basic board	9392-3	1.15	2.50
UAA170, 16 LED display board	9392-4	0.95	2.10
E13: MAY 1976			
tv tennis extensions (E7)	9363	5.60	12.35
preco, preamplifier	9398	2.40+	5.35
preco, control amplifier	9399	1.40+	3.10
equin	9401	2.55+	5.65
E14: JUNE 1976			
fet front, preamp (E7)	9413	0.85	1.95
E15/16: SUMMER CIRCUITS 1976			
7 watt IC audio amplifier	9506-1	1.35+	2.95
simple front-end for VHF-FM	9512	1.00+	2.20
Hi-Z stereo amplifier for headphones	9540	1.50+	3.30
SSB adapter	9641	0.70	1.55
E17: SEPTEMBER 1976			
tachometer, LED meter board (E12)	9392-1	1.50	3.30
tachometer, front panel (E12)	9392-2	2.00	4.40
tachometer, control board	9460	1.45	3.15
m.p.g. indicator, extension p.c.b.	9473	1.50	3.30
windscreen wiper delay, using SCR	9474-1	0.70	1.55
E18: OCTOBER 1976			
tv tennis scoring (E7, E13)	9405	5.30	11.70
loud mounth	9412	3.45+	7.60
SQ decoder	9494	7.35+	16.20
E19: NOVEMBER 1976			
intercom	9156	1.05	2.30
LOGICal replacement, etc.	9192	3.45	7.55
albar: see E25, May 1977			
albar, power supply	9437	1.15	2.50
signal horn	9438	1.05	2.30
egg-timer-with-a-difference	9469	0.55	1.20
capacicoupling tap control	9707	0.80	1.80
sensitive metal detector	9750	1.80	3.95
E20: DECEMBER 1976			
phasing and vibrato	9407	2.75+	6.05
drill speed control	9484	0.95	2.10
parking meter alarm	9491	0.90	2.00
snooze-alarm-radio-clock	9500	2.35	5.25
sirens	9751	1.40	3.10
thermometer (2 boards)	9755	3.50	7.75
E21: JANUARY 1977			
hybrid IC audio amplifier	9439	1.15+	2.50
stereo audio mixer	9444	6.55+	14.50
noise generator	9487	1.60	3.55
marbles	9753	1.55	3.40
E22: FEBRUARY 1977			
Elektorscope:			
timebase	9099-1	3.10	6.85
Y preamplifier	9099-2	3.50	7.75
low voltage power supply	9099-3	2.70	6.00
1000 V Hi-V psu (note 1)	9099-4	2.05	4.60
X and Y output amplifier	9099-5	2.95	6.50
motherboard	9099-6	3.25	6.95
2000 V Hi-V psu (note 2)	9099-7	2.95	6.50
front panel, 7 cm crt (note 1)	9361-1	2.20	4.85
front panel, time base	9361-2	1.45	3.20
front panel, vertical amp. (Y1)	9361-3	1.45	3.20
front panel, vertical amp. (Y2)	9361-4	1.45	3.20
front panel, 13 cm crt (note 2)	9410-1	4.55	10.10
front panel, focus, int. (note 2)	9410-2	0.95	
plastic crt mask (note 2)	9410-3	2.35	
note 1: needed only for 7 cm crt scope			
note 2: needed only for 13 cm crt scope			
if not indicated: needed for both models			
local radio AF	9499-1	0.70	
local radio psu	9499-2	0.70	
IC power supply	9465	1.65	
E23: MARCH 1977			
running light	9203	1.05	
variometer tuner, front end (E24)	9447-1	3.80	
OTA-PLL (E7, E24)	6029	1.40	
run rabbit, run!	9764	4.15	
E24: APRIL 1977			
Digisplay (E13)	9376	3.10	
LED VU/PPM, rectifier section	9419-1	2.35+	
LED VU/PPM, display section	9419-2	4.50+	
variometer tuner, i.f. converter (E23)	9447-2	1.65+	
variometer tuner, stereo decoder (E23)	9447-3	1.15+	
auto slide changer	9743	0.65	
signal injector	9765	0.50	
E25: MAY 1977			
model car track (E24):			
multiplex encoder	9796-1	3.10	
infra-red transmitter	9796-2	1.60	
albar (E19):			
single transducer/receiver	9815-1	1.25	
transmitter	9815-2	0.40	
E26: JUNE 1977			
precision timebase	9448	1.55	
power supply for precision timebase	9448-1	0.60	
formant: keyboard interface (E25)	9721-1	2.60+	
levitator	9763	2.35	
active loudspeaker cross-over filters (E25)	9786	1.95+	
model car track (E24, E25):			
servo amplifier	9803	0.35	
E27/28: SUMMER CIRCUITS 1977			
knotted handkerchief	9830	0.20	
distortion meter	77005	1.85+	
guitar preamp	77020	1.10+	
0 . . . 10 V supply	77059	0.95	
π-qualiser	77071	0.70+	
automatic NiCad charger	77075	0.65	
TV games	77084	2.05	
4 W car radio amplifier	77101	0.65+	
3½ digit DVM	77109	2.15	
E29: SEPTEMBER 1977			
FM mains intercom	9359	4.85	
formant (E25, E26):			
interface receiver	9721-2	1.30+	
power supply	9721-3	4.15+	
keyboard divider (one octave)	9721-4	0.75+	
logarithmic darkroom timer	9797	1.50	
CCIR test pattern generator, motherboard	9800-1	5.95	
model car track (E24 . . . E26):			
motor speed control	9829-1	0.55	
proptester	9829-2	1.55	
E30: OCTOBER 1977			
CCIR:			
daughter board 1 (E29)	9800-2	3.30	
infrared transmitter	9822	2.50+	
ioniser	9823	3.00	
Kirlian camera (two boards)	4523 9831	2.25	
model car track (E24 ... 26, 29):			
infrared receiver	9848-1	0.80	
multiplex decoder	9848-2	0.85	
E31: NOVEMBER 1977			
formant (E25 . . . E30): VCO	9723-1	8.30+	
CCIR: daughter board 2 (E29, E30)	9800-3	2.55	
video biofeedback:			
display generator	9825-1	2.55	
alpha amplifier	9825-2	2.10	
electrometer	9826-1	0.70	
sensors for electrometer	9826-2	0.65	
magnetiser	9827	0.65	

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experimenting with the SC/MP:			
RAM-I/O	9846-1	5.75	12.70
SC/MP board	9846-2	1.80	3.95
model car track (E24 . . . E30):			
transmitter power supply	9218	1.00	2.20
chassis	9850	2.85	6.35

E32: DECEMBER 1977

formant (E25 . . . E31):			
VCF	9724-1	3.40^{+}	7.45
experimenting with the SC/MP (E31): CPU	9851a	8.50	18.80
UHF TV modulator	9864	1.35	2.95
electret microphone preamplifier	9866	0.60^{+}	1.30
analogue frequency meter	9869	1.10	2.40
heating controller	9877	3.20	7.05
MW reflex receiver	9880	0.85	1.85
sensitive lightmeter	9886	0.60	1.30
stylus balance (E12)	9343	0.45^{+}	1.05
signal injector (E24)	9765	0.50	1.10
knotted handkerchief (E27/E28)	9830	0.20	0.45

E33: JANUARY 1978

simple function generator	9453	2.70	6.00
formant (E25 ... E32):			
ADSR	9725-1	3.20	7.05
UAA 180 LED voltmeter	981-7	1.75	3.90
elektor equaliser	9832	3.45^{+}	7.65
experimenting with the SC/MP (E31, E32):			
bus board	9857	3.00	6.65
memory card	9863	12.75	28.20
CMOS noise generator	9859	1.45	3.20
peak programme meter	9860	1.30^{+}	2.80

NEW:

E34: FEBRUARY 1978

formant (E25 . . . E33):			
DUAL-VCA	9726-1	3.35	7.40
development timer	9840	2.10	4.60
experimenting with the SC/MP (E31 . . . E33):			
HEX I/O	9893	17.00	37.60

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infra-red light gate

This article describes an infra-red light source and detector, which can be used in a wide variety of applications ranging from intruder alarms to automatic garage door openers. When the light beam from the infra-red source is interrupted, the receiver circuit detects this and energises a relay.

The use of an infra-red light source is an obvious choice for this type of application. In the first place, for intruder alarm applications the light beam must be invisible, which limits the choice to infra-red or ultra-violet light. Ultra-violet light can cause visible fluorescence of certain materials, which makes it less suitable than infra-red. In the second place, relatively powerful solid-state infra-red sources, and infra-red sensors, are available at modest cost, whereas there are no solid-state UV sources commercially available.

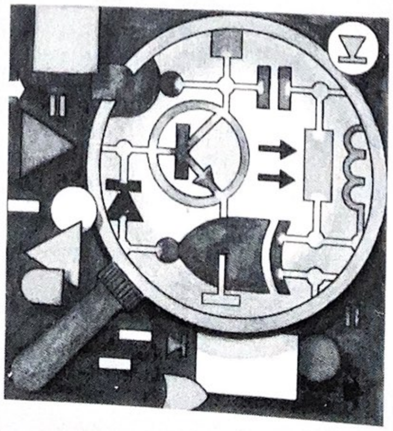
The circuit described here uses the Siemens LD 241 infra-red emitter and BPW 34 IR photodiode.

Although these devices are not exorbitantly priced, neither are they inexpensive, so in order to minimise the number of IR emitters necessary to achieve a given range the transmission system should be as efficient as possible. Since the light level received at several metres distance from the transmitter will be very low, the receiver must have a high gain. This immediately excludes the simpler types of photoelectric switch that use a continuous light beam and a DC-coupled receiver, since a high-gain DC coupled receiver amplifier would be prone to offsets, temperature drift and other effects that could lead to poor sensitivity on the one hand, or false triggering on the other.

The choice therefore falls on an AC modulated light beam and AC-coupled receiver, since a high AC gain can be achieved without offset problems. Such a system can be either narrowband or wideband. The advantages of a narrowband system are a higher signal-to-noise ratio and less susceptibility to extraneous interference, either in the form of ambient light or transients on the supply lines. The disadvantage of a narrowband system is that the transmitter and receiver frequencies have to be accurately aligned.

In a wideband system, the light source is simply pulsed on and off, and the amplification stages of the receiver have a fairly large bandwidth. The advantages of this system are simplicity and ease of alignment, but the disadvantages are poor signal-to-noise ratio and susceptibility to interference. However, advantage may be taken of the fact
infra-red emitting diode will
a peak current that is much lar
the average current (1 A peak a
100 mA continuous). Small du
high-power pulses may thus b
mitted, which will give an i
signal-to-noise ratio over a large
cycle transmission of the same
power.

The effects of external sources
ference may be reduced by
attention to constructional
mounting the unit in a screen
and suppression of the suppl
With these precautions a w
system can give quite acceptab
formance and was thus chosen
of its other advantages.



Transmitter circuit

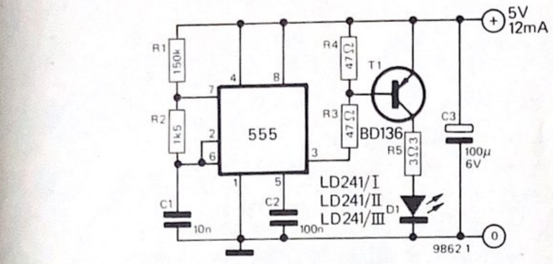
The simple transmitter circuit is
in figure 1. It consists of a 55
connected as an astable multiv
driving an output transistor
switches the IR emitter on and
duration of the transmitted light
is about 10 μs and the repetition
just less than 1 kHz. The average
drawn by the circuit is about
and the peak current through
diode is around 700 mA.

The LD241 is available in three v
LD 241/I, LD 241/II and LD
which have different radiant inte
For the same forward curren
light output of the LD 241/II
cally 1½ times, and the light ou
the LD 241/III typically 2½ time
of the LD 241/I.

The power supply for the trans
is not critical provided the
voltage is no greater than 6 V,
could result in the maximum
rating of the LD 241 being excee
suitable circuit is given in figure
can be built up on the board
'Local Radio' power supply (Elek
February 1977).

Note that the component valu
this circuit differ from those
original circuit (see parts list) an
the following components are om
R5, C2 (replaced by R6), D1,
(base and emitter connections lin
the p.c.b.).

1



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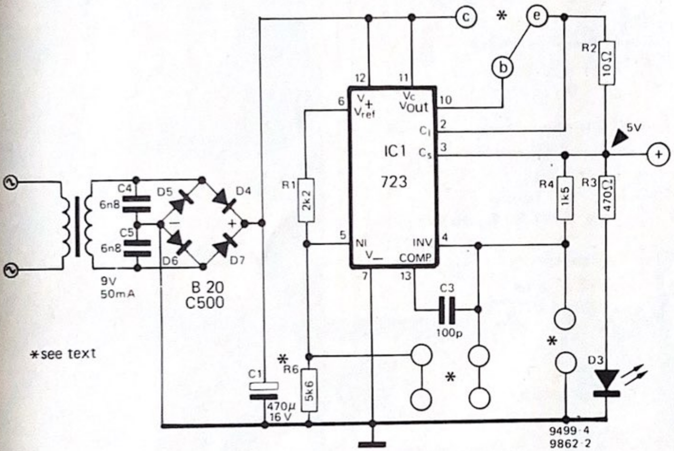


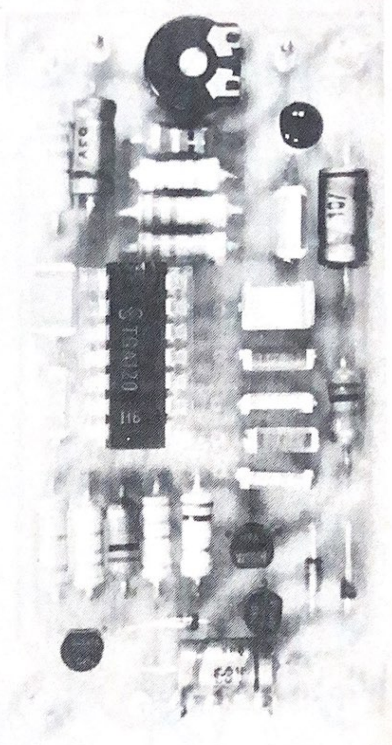
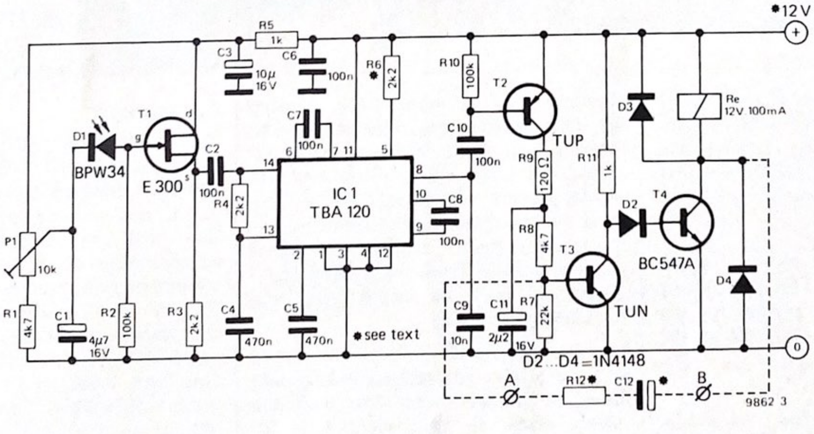


Figure 1. **Circuit of the infra-red transmitter.**

Figure 2. **The 'Local Radio' power supply may be modified to provide a 5 V supply for the IR transmitter. Since the average current is only 12 mA, the external transistor T1 may be omitted.**

Figure 3. **Circuit of the infra-red receiver.**

3



Receiver circuit

The receiver circuit is shown in figure 3. A BPW34 infra-red photodiode is operated in the reverse-bias mode. The leakage current of this diode varies with the light received from the transmitter, which causes a varying voltage to appear across resistor R2, the gate resistor of the FET source-follower T1. The signal appearing at the source of T1 is fed to IC1, which is used as an amplifier and limiter. P1 varies the sensitivity by altering the reverse bias voltage of the diode.

When light pulses are being received from the transmitter, a negative-going pulse train with an amplitude in excess of 1 V peak-to-peak appears at the output of IC1 (pin 8). This turns T2 on and off continually, charging up C11. T3 is thus always turned on, T4 is turned off and relay Re is not energised.

When then light beam between the transmitter and receiver is interrupted, the amplitude of the pulse train from the output of IC1 will fall. T2 will be cut off, C11 will discharge, T3 will turn off and T4 will turn on, pulling in the relay. Once the light beam is restored the relay will, of course, drop out again, but can be made to hold in for several seconds after the light beam has been restored by adding the components shown dotted. R12 should be